SYLLABUS

Matematical Logic and Set Theory

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	**Babeş-Bolyai University**
1.2. Faculty	**Mathematics and Computer Science**
1.3. Department	**Mathematics**
1.4. Field of study	**Mathematics**
1.5. Study cycle	**Bachelor**
1.6. Study programme/Qualification	**Mathematics Computer Science (English)**
1.7. Form of education	**Full-time**

2. Information regarding the discipline

2.1. Name of the discipline	**Matematical Logic and Set Theory**					Discipline code	**MLE0070**
2.2. Course coordinator					Prof. dr. Andrei Mărcuş		
2.3. Seminar coordinator					Prof. dr. Andrei Mărcuş		
2.4. Year of study	1	2.5. Semester	1	2.6. Type of evaluation	E	2.7. Discipline regime	Compulsory

3. Total estimated time (hours/semester of didactic activities)

3.1. Hours per week	**4**	of which: 3.2 course	**2**	3.3 seminar/laboratory	**2**
3.4. Total hours in the curriculum	**56**	of which: 3.5 course	**28**	3.6 seminar/laborator	**28**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					30
Additional documentation (in libraries, on electronic platforms, field documentation)					15
Preparation for seminars/labs, homework, papers, portfolios and essays					30
Tutorship					9
Evaluations					10
Other activities:					
3.7. Total individual study hours	**94**				
3.8. Total hours per semester	**150**				
3.9. Number of ECTS credits	**6**				

4. Prerequisites (if necessary)

4.1. curriculum	Profound knowledge of high school math, especially of the following topics: - elements of propozitional and predicate calculus - operations with sets - functions; - injectivity, surjectivity, bijectivity - number sets - divizibility in Z; primes;

	- modular arthmetic - counting arguments
4.2. competencies	- ability to perform symbolic calculations ability to operate with abstract concepts - ability to do logical deductions - ability to solve math problems based on aquired notions

5. Conditions (if necessary)

5.1. for the course	**blackboard, projector**
5.2. for the seminar /lab activities	**blackboard**

6.1. Specific competencies acquired [1]

Professional/essential competencies	• C1.1 Identifying the notions, describing the theories and using the specific language. • C2.3 Applying the adequate analytical theoretical methods to a given problem
Transversal competencies	• CT1. Applying some rules of precise and efficient work, showing a responsible attitude regarding the scientific domain and teaching training for an optimal and creative development of the personal potential in specific situations, respecting the deontological norms.

6.2. Learning outcomes

Knowledge	The student: - has acquired the specific skills of mathematics-related disciplines necessary for completing assignments. - knows fundamental notions related to logic and set theory as well as methods of applying them in fields of science related to mathematics and computer science.
Skills	The student is able to: - construct clear and well-supported mathematical arguments to explain mathematical problems, topics and ideas in writing. - prove theorems using mathematical language in theoretical courses and will be able to present these results both orally and in writing.

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

Responsibility and autonomy:	The student has the ability to - independently explore certain mathematical contents, drawing on previously acquired ideas and tools, in order to extend his/her knowledge. - independently extend previously acquired mathematical ideas and arguments to a mathematical topic that has not been previously studied.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Basic knowledge on First Order Logic, Set Theory, and Arithmetic. Ability to solve difficult problems
7.2 Specific objective of the discipline	• students will operate with fundamental concepts of logic, set theory and number theory • students will aquire knowlegde first order predicates, relations, equivalence, cardinals and ordinals, number systems, divisibility, congruences, combinatorics. • students solve problems, theoretical and practical, using instruments of modern mathematics.

8. Content

8.1 Course	**Teaching methods**	**Remarks**
Week 1. Propositional Logic. Formulas, truth values, tautologies.	Explanation, dialogue, examples, proofs	
Week 2. Normal forms in propositional logic. First order Logic. Predicates, quantifiers.	Explanation, dialogue, examples, proofs	
Week 3. Methods of mathematical proof. Sets and operations with sets.	Explanation, dialogue, examples, proofs	
Week 4. Binary relations. Functions. Injective, surjective, bijective functions.	Explanation, dialogue, examples, proofs	
Week 5. Equivalence relations and partitions, factor sets, kernel of a function.	Explanation, dialogue, examples, proofs	
Week 6. Factorization of functions	Explanation, dialogue, examples, proofs	
Week 7. Ordered sets, lattices.	Explanation, dialogue, examples, proofs	
Week 8. Boole algebras and Boole rings.	Explanation, dialogue, examples, proofs	
Week 9. Axiomatic number theory. The Frege-Russell constructions and the Peano axioms	Explanation, dialogue, examples, proofs	
Week 10. Construction of integers and rationals.	Explanation, dialogue, examples, proofs	
Week 11. Cardinal numbers. Operations with cardinal numbers.	Explanation, dialogue, examples, proofs	
Week 12. Ordering cardinal numbers. Finite, countable, infinite sets.	Explanation, dialogue, examples, proofs	
Week 13. Elements of Combinatorics. Counting arguments.	Explanation, dialogue, examples, proofs	
Week 14. Ordinal Numbers.	Explanation, dialogue, examples, proofs	
Bibliography 1. Marcus, A.: *Logică şi teoria mulţimilor*, Casa Cărţii de Ştiinţă, Cluj-Napoca, 2022. 2. Breaz, S.; Covaci, R.: *Elemente de logica, teoria mulţimilor si aritmetica*, Editura Fundaţiei pentru Studii Europene, Cluj-Napoca, 2006.		
8.2 Seminar / laboratory	**Teaching methods**	**Remarks**

Week 1. Propositional Logic. Formulas, truth values, tautologies.	Explanation, dialogue, examples, proofs	
Week 2. Normal forms in propositional logic. First order Logic. Predicates, quantifiers.	Explanation, dialogue, examples, proofs	
Week 3. Methods of mathematical proof. Sets and operations with sets.	Explanation, dialogue, examples, proofs	
Week 4. Binary relations. Functions. Injective, surjective, bijective functions.	Explanation, dialogue, examples, proofs	
Week 5. Equivalence relations and partitions, factor sets, kernel of a function.	Explanation, dialogue, examples, proofs	
Week 6. Factorization of functions	Explanation, dialogue, examples, proofs	
Week 7. Ordered sets, lattices.	Explanation, dialogue, examples, proofs	
Week 8. Boole algebras and Boole rings.	Explanation, dialogue, examples, proofs	
Week 9. Axiomatic number theory. The Frege-Russell constructions and the Peano axioms	Explanation, dialogue, examples, proofs	
Week 10. Construction of integers and rationals.	Explanation, dialogue, examples, proofs	
Week 11. Cardinal numbers. Operations with cardinal numbers.	Explanation, dialogue, examples, proofs	
Week 12. Ordering cardinal numbers. Finite, countable, infinite sets.	Explanation, dialogue, examples, proofs	
Week 13. Elements of Combinatorics. Counting arguments.	Explanation, dialogue, examples, proofs	
Week 14. Ordinal Numbers.	Explanation, dialogue, examples, proofs	

Bibliography

1. Adamson, I.: A Set Theory Workbook. Birkha"user, Boston, 1998.
2. Epp, S.: Discrete Mathematics with Applications. 4th ed. Brooks/Cole, Boston, 2011.
3. Levy, A.: Basic Set Theory. Dover Publications, New York, 1979.
4. Lidl, R., Pilz, G.: Applied Abstract Algebra. Springer-Verlag, Berlin, 1998.
5. Ross, K. A., Wright Ch., Discrete Mathematics. Pearson Education, New Jersey, 2003.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- Such a course (often called Discrete Mathematics) exists in the curricula of all major universities in Romania and abroad.
- Mathematical Logic and Number Theory are fundamental topics and have multiple applications in other branches of mathematics, as well as in Computer Science and in Philosophy.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	- know the basic principles of the field. - apply the new concepts.	- Written exam	80%
10.5 Seminar/laboratory	- problem solving	- homeworks	20%
10.6 Minimum standard of performance			
• to aquire minimum 5 (out of 10) points to pass the exam			

11. Labels ODD (Sustainable Development Goals)[2]

	General label for Sustainable Development							
								

Date:
11.04.2025

Signature of course coordinator

Prof. dr. Andrei Mărcuş

Signature of seminar coordinator

Prof. dr. Andrei Mărcuş

Date of approval:
25.04.2025

Signature of the head of department

Prof. dr. Andrei Mărcuş

[2] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable.*”.